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Improving the Quality of Life Through Manpower Planning

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NEED FOR MANPOWER PLANNING

The quality of human life is dependent upon many factors - the bounty of natural resources, the viability of social institutions, the availability and application of technology and perhaps most importantly, the quality and use of human resources.

People develop and make the institutional arrangements and technology work to produce the goods and services which result in our lifestyle. Conversely, the role of each individual in providing these goods and services is a primary factor in his perception as to the quality of his life.

Currently, there are major national concerns as to how human resources are being developed and used.

..... Business Week devoted a special issue to "Productivity - Our Biggest Undeveloped Resource". BW pointed out that while the U.S. has the highest level of productivity in the world, there is potential for even greater gains. To convert that potential, steps must be taken to devise new incentives and better utilize workers.

..... Ivar Berg, in "The Great Training Robbery" argued that many occupations have artificially high entry requirements resulting in excessive education cost and barriers to entry and advancement by the poor.

..... In his recent book "Working", Studs Terkle vividly describes the disenchantment of many workers with their jobs.

..... One out of every six workers is employed in the public sector. The feeling of the general public that the services rendered are not proportionate to the costs is supported by the frequent newspaper accounts of public service failures.

..... Many recent college graduates are unemployed or underemployed because

they acquired unneeded skills while a shortage of engineers is looming.

It is generally accepted that there is need to improve the means for developing and utilizing human resources for the mutual benefit of society and the individual. I believe that Manpower Planning, an emerging function, can contribute to this. My purpose in this paper is to draw the attention of Industrial Engineering Educators to this technology and suggest that they become involved in its development and application.

Definition

Early publications on manpower planning which, at the organizational level, emanated from personnel management specialists, defined manpower planning in terms of its purpose - "Manpower Planning is the process by which the firm insures that it has the right number of people and the right kind of people, at the right places, doing the things for which they are economically most useful."

Frank Cassell later suggested a more operational definition. "The purpose of corporate manpower planning is to tie together decisions concerning recruiting, screening, compensation, training, job structure, avenues of mobility and work rules in such a way as to provide cost trade offs and decision options which can be ranked according to various forms of advantage."

THE MANPOWER PLANNING PROCESS

Manpower planning is essentially a process embodying a number of tools and related tasks. A basic tool is an occupational structure. Each job category of an organization needs to be labeled and defined. The definition to include the relationships with other jobs, the tasks performed, the job qualifications in terms of general education, and the specific vocational

training, aptitudes, and physical requirements. Similarly, the various categories of training and the relationship of the training categories to the skills and knowledge requirements of the various occupations must be labeled and defined.

Whereas the occupation structure is concerned with the qualitative requirements of work, manpower planning also requires a means to relate the number and types of personnel with various types and levels of workload. These relationships, in the form of staffing guides, can be developed through application of work measurement techniques.

Also necessary is a systematic process to compile and analyze manpower data in conjunction with the programming and decision making process of the organization. A basic element of this analysis is the translation of projected workload into manpower demand. The work to be done can be defined and dimensioned in the program plans of the organization. The staffing guides are used to translate the workload into manpower demand.

On the basis of the manpower demand forecast and information concerning the current workforce and external supply, a model can be applied to calculate the new hires and promotions that will be needed to fill expansion needs and replace losses from resignations and retirements of each personnel category for each of the years in the period being covered by the forecast. The model provides for consideration of career patterns and attrition rates and the flow of personnel into, through, and from the pipeline. Higher level personnel categories will be filled from lower ones, leaving vacancies in lower level categories which must be filled, and this chain continues until determination can be made as to the number of new

employees who must be recruited. Determinations must also be made concerning retraining of personnel in categories with decreasing workloads and number of employees requiring training for skill retention, advancement and new technology.

The next step is to formulate action plans to meet these needs. With knowledge of the current manpower inventory and training resources, the manpower planner can formulate recruitment and training programs. However, there are other actions that might be taken. For example, if a large number of new hires are needed because of turnover, a program might be undertaken to increase salaries or improve working conditions. Also, external factors should influence the manpower programs. If there is a shortage of professionals or highly skilled blue-collar workers, the work might be restructured to make better use of available capabilities. If there is a shortage of labor, systems might be redesigned to gain the benefits of automation. If there is unemployment, jobs might be restructured to make them available to the disadvantaged. Also, high demands might result from inefficient systems. Therefore, action programs might be directed to improving manpower utilization through application of industrial engineering methods.

The preceding described the basic manpower planning process. Its implementation, of course, must be related to the size, capabilities, and interests of the individual organization.

TYPES AND APPLICATIONS OF MANPOWER PLANNING

At the micro, or organization level, most private organizations recognize the need for manpower planning and accomplish some of the tasks for some of their personnel. A few major firms are reported to have so-

phisticated systems. The armed forces probably have the most comprehensive operational manpower planning systems which are fully computerized. Little manpower planning is done by government organizations, However, in response to recommendations of a Presidential Task Force on Management Improvement, the U.S. Civil Service Commission is developing guidelines which are expected to require federal agencies to establish manpower planning capabilities.

At the "macro-level", the Bureau of Labor Statistics compiles data and makes short and long-range forecasts and analyses of manpower demand and supply using sophisticated econometric models. Data sources include the census, operational reports and surveys of state employment services and special BLS surveys. The manpower forecasts and analyses are used for the formulation of national manpower policies and programs and production of "Occupational Outlook" reports which are used for guidance counseling throughout the nation.

Perhaps because of the shortcomings of national manpower programs in the past, the Administration, as authorized by the Comprehensive Employment and Training Act of 1973, is endeavoring to further develop the manpower planning capabilities on the staff of each Governor's office and the Office of the Mayor, or other decision maker, in jurisdictions of over 100,000 population. It will be the task of each of these Manpower Councils to assess the employment and manpower development needs of their area labor market and make optimal decisions on the use of federal funds received through manpower revenue sharing as well as local funds. The U.S. Employment Service and the Bureau of Labor Statistics are developing mechanisms for the generation and communication of manpower information in each planning area. The methods and institutional arrangements for this "area labor

market manpower planning" are in the developmental phase and primarily directed to the problems of unemployment and the disadvantaged. However, it is expected that the capability will eventually be linked to the planning of public education programs.

Another type of manpower planning is labeled "industry specific". The Public Health Service, and the Environmental Protection Agency as well as other government agencies and industrial and professional associations conduct manpower demand and supply studies and formulate action programs to rectify imbalances for their areas of responsibility or concern. These are primarily done at the national level, but there is a movement to establish manpower planning capabilities at the local level. The Public Health Service requires each comprehensive Health Planning Council to have a manpower planning capability. A federal-state-local manpower system for water pollution control is being implemented by the Office of Water Programs of EPA.

FEDERAL-STATE-LOCAL MANPOWER PLANNING SYSTEM FOR WATER POLLUTION CONTROL

Essentially, EPA is endeavoring to establish a manpower planning capability in the water quality agency of each local planning area and each state. EPA intends that the local manpower planner determine the manpower and training needs for water pollution control of public and private organizations in his jurisdiction and then with the Manpower Council in the Office of the Mayor, employer and employee associations, and the education institutions plan programs to meet the needs.

The role of the state water quality agency manpower planner is to assess the overall manpower and training needs of the state relative to supply, then with counterpart manpower and education agencies plan programs

to support and to fill the gaps of the local programs.

The Federal Government can then help fill the gaps of the state training programs, especially in transferring new technology and training instructors. The primary EPA role, in addition to providing assistance in the establishment of capabilities, involves doing things that can best be done centrally; e.g., developing manpower planning methods and tools and instructional materials that can be adapted to the needs of individual jurisdictions. Also, EPA is the advocate of water pollution control manpower and training needs to the federal agencies which have primary manpower responsibilities - the Department of Labor, Office of Education and Civil Service Commission. With them, EPA endeavors to develop and coordinate programs to meet mutual objectives.

EPA also recognizes the contributions that can be made by the American Water Works Association, Water Pollution Control Federation and the members and staffs of other professional and employer associations of the water field. With them, EPA is developing vertical and horizontal communication at all levels so that the capabilities of their members can be drawn upon to meet needs.

ROLE OF INDUSTRIAL ENGINEERING EDUCATORS.

I appreciate this opportunity to present my views on manpower planning to the Industrial Engineering section of the Engineering Education Conference. I believe that IE educators and practioners can contribute to the development and application of manpower planning technology. IE encompasses many of the tools of manpower planning. Systems analysis approaches can facilitate understanding and establishing the interdisciplinary and institutional relationships required for effective manpower development and

utilization. Therefore, I think it proper to suggest that Industrial Engineering faculties be involved in advancing the state of the art and educating persons in this field.

Definitive studies have not been made as to the specific skills and knowledges that a manpower planner should have or the appropriate education for entry and progress in the field. Also, no assessment has been made as to current and future employment in the field. Nevertheless, I am certain that there are extensive education and training needs in this field. Baccalaureate and graduate programs are required to prepare young people to enter the field and continuing education programs are needed for those already engaged. Managers need to be made aware of this technology and the institutional arrangements for manpower planning and development. Engineers need to learn how to give proper consideration to the manpower implications of their designs.

This education must be interdisciplinary in nature as Manpower Planning draws upon the concepts and tools of labor economics, the behavioral sciences, educational technology, personnel management, the management sciences and industrial engineering. Within the firm its application involves decisions and inputs from line executives and practically all the staff departments. And the manpower programs of the firm must be coordinated with related activities of the community, industry and professional associations.

I trust you agree that integration of these diverse disciplines and interests to meet societal and individual concerns for human resource development and utilization can contribute to the quality of life and is an appropriate concern for industrial engineering educators.

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MANPOWER PLANNING RESOURCES

PLANNING CRITERIA (10)

1. Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities. Prepared by W. L. Patterson and R. F. Banker of Black & Veatch Consulting Engineers, for the Office of Research and Monitoring, U.S. Environmental Protection Agency, Washington, D.C., 1971. (Available at the U.S. Government Printing Office)

251 pages. Contains occupational definitions, staffing guides, and productivity measures, together with instructions for estimating costs and manpower requirements for conventional wastewater facilities (1-100 MGD).

2. Estimating Staffing and Cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD*, Part I - Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. Prepared by the Department of Industrial Engineering and Engineering Research Institute, Iowa State University, for the Manpower Development Staff, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C., 1973.

126 pages. The purpose of this study is to develop occupation descriptions and specifications for conventional waste treatment facilities having an average design flow of 0-1 MGD; and to provide time requirement estimates for job tasks in such a manner as to provide bases for staff planning.

3. Estimating Staffing for Municipal Wastewater Treatment Facilities. Prepared by the Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C., 1973. (Available at the U.S. Government Printing Office)

96 pages. Intended for use by consulting engineers, plant management personnel, and State regulatory agencies, this manual not only provides productivity measures for various wastewater treatment plant processes and functions, but also describes a four-step method for preparing staffing estimates for sewage treatment plants. It covers plants with capacities of from 0.5 to 25 MGD of sewage using primary, secondary, and advanced treatment processes.

*Million Gallons Per Day

4. Manpower Requirements for Wastewater Collection Systems in Cities of 150,000 to 500,000 in Population. Prepared by Elie Namour of the Center for Manpower Research and Training, North Carolina A&T State University, Greensboro, North Carolina, for the Manpower Development Staff, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D. C., 1974.

182 pages. This manual identifies specific manpower requirements in terms of types and numbers of personnel that are needed to operate and maintain wastewater collection systems efficiently in cities of from 150,000 to 500,000 in population. Occupational descriptions and descriptions of tasks are provided.

5. Research Report: Manpower Requirements for Wastewater Collection Systems in Cities and Towns Up to 150,000 in Population. Prepared by Elie Namour of the Center for Manpower Research and Training, North Carolina A&T State University, Greensboro, North Carolina, for the Manpower Development Staff, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C., 1973.

49 pages. This manual describes the methodology used in the development of the manpower planning criteria manual, Manpower Requirements for Wastewater Collection Systems in Cities and Towns Up to 150,000 in Population.

6. Study of Manpower Needs for Implementation of the Water Pollution Control Act Amendments of 1972 - Report No. 2: Manpower Planning Criteria Manual for State Water Pollution Control Agencies. U.S. Environmental Protection Agency, Washington, D.C., 1975.

200 pages. This manual is a compilation of the manpower planning criteria used in Report No. 1: Estimate of State Water Pollution Control Agency Manpower Needs. The manpower planning criteria presented consists of function definitions, associated occupation definitions, staffing guides for estimating manpower requirements, productivity measures, and rationale statements.

OCCUPATIONAL DEFINITIONS (11)

7. Dictionary of Water and Water Pollution Control Occupations. Manpower Planning Branch, Manpower Development Staff, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C., 1972.

47 pages. Extracted from the Department of Labor's Dictionary of Occupational Titles, this dictionary describes the duties peculiar to each occupational title.

8. Guide Class Specifications for Air-Pollution Control Positions in State and Local Programs. Office of State Merit Systems and Technical Assistance, U.S. Civil Service Commission, and the Office of Manpower Development, Office of Air Programs, U.S. Environmental Protection Agency, Washington, D.C., 1971.

36 pages. This pamphlet gives definitions, examples of duties, and minimum qualifications for air pollution control positions at the State/local level.

9. Task Analysis of State and Local Air Pollution Control Agencies, and Development of Staffing Guidelines. Prepared by Applied Science Associates, Inc., of Valencia, Pa., for the Office of Air Programs, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, 1972.

Eight Volumes.

a. Technical Report, 74 pages.

b. Volume A: Introduction and Directions for Using These Guidelines, 52 pages.

c. Volume B: Detailed Task Data and Staffing Guidance - Engineering Services, 114 pages.

d. Volume C: Detailed Task Data and Staffing Guidance - Field Enforcement, 55 pages.

e. Volume D: Detailed Task Data and Staffing Guidance - Laboratory Support, 70 pages.

f. Volume E: Detailed Task Data and Staffing Guidance - Air Monitoring and Meteorological Support, 105 pages.

g. Volume F: Detailed Task Data and Staffing Guidance - Source Testing, 49 pages.

h. Volume G: Detailed Task Data and Staffing Guidance - Agency Management Program Development and Public Information Support, 95 pages.

The Technical Report provides a data base which describes the tasks to be performed by control agency personnel, and the skills and knowledge personnel must have to perform the tasks effectively. Guidance concerning the use of the data base in making staffing decisions is included in Volumes A-G.

MANPOWER PLANNING METHODOLOGIES - GENERAL (20)

10. Micromanpower Planning in the Public Sector. Prepared by J. Kenneth Davies and Colin Wright for the Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C., 1975.

598 pages. This book expands upon the publication, Manpower Planning for Wastewater Treatment Plants, providing guidance on manpower planning methods as well as providing conceptual information on labor economics, human engineering, institutional arrangements, etc.

MANPOWER PLANNING METHODOLOGIES APPLICABLE TO STATE AREA MANPOWER PLANNING FOR FACILITIES (21)

11. Manpower Planning for Municipal Wastewater Treatment in Texas. Prepared by the Environmental Education and Training Section, Texas Water Quality Board, to complete FY '76 "106" commitment to the U.S. Environmental Protection Agency, Region VI, Dallas, Texas.

151 pages. This pamphlet descrives the methods employed and the results derived during a manpower forecast and analysis of training loads for wastewater treatment personnel in Texas. In addition, it provides age and educational characteristics of Texas municipal treatment plant certified personnel.

12. Manpower Planning for Wastewater Treatment Plants. Prepared by the Olympus Research Corporation for the Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C., 1973.

212 pages. This book provides methodologies and related guidance to State agency manpower planners.

MANPOWER PLANNING METHODOLOGIES APPLICABLE TO MANPOWER PLANNING WITHIN ORGANIZATIONS (22)

13. Developing A Local & Regional Solid Waste Management Plan. Richard Toftner, U.S. Environmental Protection Agency, Washington, D.C. (Available at the U.S. Government Printing Office)

29 pages. This publication has as its purpose the describing of the basic features of the planning process and how a local or regional agency may use this in developing a solid waste management plan. Three pages are given to manpower factors.

14. Manpower Planning Methodology: Work and Manpower Planning for A State Water Pollution Control Agency. Manpower Planning and Training Branch, Municipal Operations and Training Division, Office of Water Program Operations, U.S. Environmental Protection Agency, 1976.

41 pages. Provides a body of instructions that can be used by line managers and functional staffs of State water pollution control agencies to ensure that manpower factors are properly considered and provided for in their program planning process.

COMPUTERIZED MANPOWER FORECASTING AND ANALYSIS METHODOLOGIES (30)

15. Manpower Planning Model. Prepared by David A. Lynn and Gordon L. Deane, GCA Corporation, Bedford, Massachusetts, for the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, 1975.

225 pages. This report presents a computerized manpower planning model designed to estimate the manpower requirements of non-Federal air pollution control (APC) agencies and thereby to serve as a planning tool for projecting the effects on manpower levels of various policy decisions.

TASK ANALYSIS - OCCUPATIONAL METHODOLOGIES (40)

16. Pilot Study to Determine Manpower Requirements for Conventional Sewage Treatment Plants. John A. Whittenburg, Manpower and Training Division, Federal Water Pollution Control Administration, Washington, D.C., 1970.

125 pages. This publication describes the limited application of a human factors approach to the problem of developing manpower planning criteria for conventional sewage treatment plants. A brief examination is made of three alternative approaches to the development of occupation definitions and staffing guides.

METHODOLOGY FOR ANALYZING IMPACT OF NEW LEGISLATION ON MANPOWER AND TRAINING NEEDS (51)

17. Study of Manpower Needs for Implementation of the Water Pollution Control Act Amendments of 1972 - Report No. 1: Estimate of State Water Pollution Control Agency Manpower Needs. U.S. Environmental Protection Agency, Washington, D.C., 1975.

48 pages. This report provides estimates of manpower needed for implementation of the Federal Water Pollution Control Act Amendments of 1972. It describes the methodology used for assessing the impact of the legislation on State agency manpower requirements.

METHODOLOGY FOR ANALYZING IMPACT OF NEW TECHNOLOGY ON MANPOWER AND TRAINING NEEDS (52)

18. Manpower Factors Manual. Prepared by Synectics Corporation for the Manpower Planning Branch, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C., 1971.

149 pages. The purpose of this manual is to provide information and specifications which supplement FWQA Commissioner Order 5050.2, "Consideration of Manpower Factors in System Design and Analysis." Additional purposes are to provide guidance in the generation of information required by the Manpower and Training Division's Manpower Planning Program and to serve as a primer in manpower factors technology.

19. U.S. Department of the Interior Order COM 5050.2 - Subject: Consideration of Manpower Factors in System Design and Analysis. Federal Water Quality Administration, Washington, D.C., 1970.

5 pages. This order provides information for insuring that the manpower factor is properly considered in the development of water quality management systems of the National Water Pollution Control Program.

METHODOLOGY FOR CONDUCT OF MANPOWER SURVEYS FOR ANALYSIS OF MANPOWER/TRAINING SUPPLY AND DEMAND (60)

20. A National Survey of Manpower Utilization and Future Needs of Consulting Engineering Firms Engaged in Water Pollution Control. Prepared by E. Joe Middlebrooks in cooperation with the Consulting Engineers Council and the Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C., 1972.

129 pages. This describes the questionnaire used and presents a summary of the responses received from 941 architectural and engineering firms around the United States.

21. Manpower Planning for Municipal Wastewater Treatment - Michigan: 1972-1976. Prepared by Peter S. Walters, Municipal Wastewater Division, Bureau of Water Management, Michigan Department of Natural Resources, for the U.S. Environmental Protection Agency, Washington, D.C., 1974.

105 pages. This study uses questionnaires and personal interviews at wastewater treatment plants to gather data and make projections (primarily on a geographic level) concerning trends in employment and training. This report describes the methodology used, and presents tabulations and analyses of the data gathered.

22. Manpower Utilization and Future Needs of Manufacturing Industries in Water Pollution Control. Prepared by E. Joe Middlebrooks, Utah State University, with support of the Municipal Permits & Operations Division, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C., 1974.

90 pages. This study describes a combination of data analysis methods developed for various industry categories, and provides estimates of manpower and training requirements (professional and technical) for water pollution control activities.

23. Manpower Analysis: Municipal Wastewater Treatment Facilities in New England. Prepared by the New England Board of Higher Education's Student Internship in Economic Development Program, under a manpower planning grant from the U.S. Environmental Protection Agency, Waltham, Massachusetts, 1972.

192 pages. On the basis of questionnaires and plant site visits, this report describes characteristics of the work force in wastewater treatment plants in six New England States. Methodologies are described. Data on the number and type of training courses available to operators, as well as projections on the future manpower needs of the industry, is provided.

24. New York State Manpower Study for Municipal Wastewater Treatment. Office of Environmental Manpower, New York State Department of Environmental Conservation.

85 pages. This report provides the results of a survey of salary and staffing patterns studied in New York State (New York City is excluded), and illustrates a model of manpower planning principles which were developed and could be applied in other States.

COST - BENEFIT METHODOLOGY (70)

25. Effectiveness Evaluation of Operator Training Conducted Under the PSC Program. Prepared by J. Craig McLanahan and R. Clark Tefft for the Public Service Careers Section, State & Local Manpower Development Branch, Manpower Development Staff, U.S. Environmental Protection Agency, Washington, D.C., 1972.

67 pages. Using (1) an analysis of the performance of a sample of wastewater treatment plants, (2) a survey of water quality board supervisors, and (3) a statistical correlation between operator training and plant performance, this report shows a favorable cost-benefit relationship between operator training and plant performance in Texas. The cost-benefit methodology described may be useful in other areas.

26. Training Water Utility Employees Doesn't Cost ... It Pays. Prepared by J. P. Reames, Water Distribution Division, Dallas Water Utilities Department, for the Public Service Careers Section, Office of Education and Manpower Planning, U.S. Environmental Protection Agency, Washington, D.C., 1973.

13 pages. This report reveals the desirable effects of training on the retention of workers in entry jobs in the Water Distribution Division of the Dallas Water Utilities Department. The methodology is described.

METHODOLOGY FOR IMPROVING RECRUITMENT, RETENTION, AND MANPOWER UTILIZATION PRACTICES (80)

27. Application of Selected Industrial Engineering Techniques to Wastewater Treatment Plants. Prepared by Charles Mallory and Robert Waller for the Office of Research and Monitoring, U.S. Environmental Protection Agency, Washington, D.C., 1973.

227 pages. This is a study performed to evaluate the applicability of various industrial engineering techniques to operation and maintenance of secondary waste treatment plants. The conclusion reached is that industrial engineering techniques should be more universally applied in the planning, design, maintenance, operation, and management of wastewater treatment plants.

28. Handbook for Achieving Adequate Salaries for State Environmental Positions. Prepared by Blazer, Zeni & Co. for the Water Planning Division, U.S. Environmental Protection Agency, Washington, D.C., 1976.

74 pages. The purpose of this handbook is to assist State environmental administrators in achieving adequate salaries for environmental positions in order to improve recruitment and retention. In particular, it provides specific guidance on ensuring proper job structuring and classification.

NEW ACQUISITIONS

29. Air Pollution Control Strategy Resource Estimator. User's Manual. Developed by the Energy and Environmental Systems Division, Argonne National Laboratory, for the Control Programs Development Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, 1977. (30)

pages. This is a computerized methodology for evaluating the impact of alternative air pollution control strategies upon the operations and budgets of State and local air pollution control agencies. The User's Manual, which will be completed within a matter of days, allows individuals to access the model by familiarizing them with both the kinds of information that are available and the data requirements necessary for use.

30. Methodology for Assessing the Demand and Supply of Manpower and Training Resources for Wastewater Treatment Plants - Draft. Prepared by the Manpower Planning and Training Branch, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C., 1977. (60)

54 pages. Provides instructions and formats for (1) estimating current and future employment levels, new hire requirements, and training needs of wastewater treatment facilities; (2) compiling data concerning training delivery resources; and (3) presenting analyses relating manpower and training needs relative to supply.